ELECT

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1 $L = 2m$, $V_1 = 5m/s$, $P/\rho = 2.5m/\text{s}$
$V_2 = 2m/s$

$$h = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.161m$$

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + Z_2$$

where $Z_1 = 2$, $Z_2 = 0$

$$2.5 + \frac{5^2}{2 \times 9.81} + 2 = \frac{P_2}{\rho g} + \frac{2^2}{2 \times 9.81} + 0 + 0.16$$

$$5.774 = \frac{P_2}{\rho g} + 0.363$$

$$\frac{P_2}{\rho g} = 5.774 - 0.363$$

$$= 5.41m$$

2 diameter at ~~throat~~ inlet

$d_1 = 20cm$

$$a_1 = \frac{\pi}{4} \times (20)^2 = 314.16cm^2$$

diameter at throat

$d_2 = 10cm$

$$a_2 = \frac{\pi}{4} \times 10^2 = 78.74cm^2$$

$P_1 = 17.658 N/cm^2 = 17.658 \times 10^4 N/m^2$

For water 1000 kg/m³

$$\frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{9.81 \times 1000} = 18m \text{ of water}$$

$$\frac{P_2}{\rho g} = -30cm \text{ of mercury}$$

$$= -0.3 \times 13.6 = -4.08 \text{ of water}$$

differential head

$$h = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 - (-4.08)$$

$$= 18 + 4.08 = 22.08m \text{ of water}$$

$$= 2208 \text{ cm}$$

$$Q = Cd \cdot \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

$$= 0.98 \times \frac{314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.74)^2}} \times \sqrt{2 \times 981 \times 2207}$$

$$= \frac{50328837.21}{304} \times 165555 \text{ cm}^3/s$$

$$= 165.555 \text{ lit/s}$$ //

3 diameter of orifice

$d_0 = 15 cm$

$\therefore$ Area, $a_0 = \frac{\pi}{4}(15)^2 = 176.7 cm^2$

diameter of pipe

$d_1 = 30 cm$

Area $a_1 = \frac{\pi}{4}(30)^2 = 706.85 cm^2$

$S_0 = 0.9$, $x = 50 cm$

diff head $h = x\left[\frac{S_g}{S_0} - 1\right]$

$50\left[\frac{13.6}{0.9} - \right] cm$

$= 50 \times 14.11 = 705.5 cm$ of oil

$C_d = 0.64$

$$Q = C_d \cdot \frac{a_0 a_1}{\sqrt{a_1^2 - a_0^2}} \times \sqrt{2gh}$$

$$= 0.64 \times \frac{176.7 \times 706.85}{\sqrt{(706.85)^2 - (176.7)^2}} \times \sqrt{2 \times 981 \times 705.5}$$

$$= \frac{94046317.78}{684.4} = 137414.25 cm^3/s$$

$= 137.4$ litres/s

4 mercury level . $x = 170mm = 0.17m$

$Sg = 13.6, \quad S_0 = 1.026$

$$h = x\left[\frac{Sg}{S_0} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right]$$

$$= 2.0834m$$

$$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.0834}$$
$$= 6.393 m/s$$

$$\frac{6.393 \times 60 \times 60}{1000} = 23.01 km/hr$$

5 $Q = 0.05 m^3/min = 50 dm^3/min$

$P = 15 bar = 15 \times 10^5$

speed m/s $= 1700 r/m$

$T = 15 Nm \quad ND = 10 cm^3/rev$

1) Ideal flow rate = nominal flow rate × speed

$= 10 cm^3/rev \times 1700 rpm$

$= 17000 cm^3/min$

$= 0.017 m^3/min$

Volumetric efficiency $= \frac{\text{Actual flow}}{\text{ideal flow}}$

$= \frac{0.05}{0.017} = 2.94\%$

294%

(ii) $Q = \frac{0.05}{60} = 83.3 \times 10^{-5} m^3/sec$

Fluid power = $P \times Q$

$= 83.3 \times 10^{-5} m^3/sec \times 15 \times 10^5 N/m^2$

$= 1250$ watts

Shaft power $= \frac{2\pi NT}{60} = \frac{2\pi \times 1700 \times 15}{60}$

$= 2670.4$ watts

Overall efficiency = fluid power / shaft power

$$= \frac{1250}{2670.4} = 0.47$$

∴ Efficiency is at 47%